TITLE

APPARATUS FOR REMOVING IMPURITIES FROM EFFLUENT WASTE GAS STREAMS

Field of the invention

The present invention relates to an apparatus for removing impurities from effluent waste gas streams, and in particular to an apparatus for removing fluorinated and chlorinated compounds from effluent waste gas streams from semiconductor etch and deposition processes.

Description of the related art

Fluorinated and chlorinated compounds are used in semiconductor etch and deposition processes. These compounds are suspected of causing global warming and environment pollution and contamination, and should be removed.

Scrubbing apparatuses made by STMI EcoSys Corporation have been widely used by semiconductor manufacturers. Among these scrubbing apparatuses, the ES Vector Series Models (for example, the ES-100 model) uses plastic packing therein to let effluent gas streams from semiconductor etch and deposition processes contact with a liquid (for example, water) so that the impurities in the effluent gas streams can be absorbed into the water and removed. However, the plastic packing needs replacement after a period of treatment time and bubbles form in the plastic packing when the scrubbing apparatus is used. These disadvantages limit the total flow rate (indicating the efficiency of the scrubbing apparatus) of the waste gas streams through the ES-100 type scrubbing apparatus to only 2831 liters/m^3.

Incineration has been shown an effective means of removing the impurities in the effluent gas streams from semiconductor etch and deposition processes. The Delatech of the CDO series of the ATMI EcoSys Corporation incinerates waste gas streams at a temperature of 850°C. However, the total flow rate of the waste gas streams using the Delatch is only about 300 liters/m^3. And chlorine gas produced in the incineration is a flammable gas which is explosive and hazardous to both personnel and equipment because of its corrosivity and in some cases toxicity.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide an apparatus for removing impurities from waste gas streams that can eliminate the above disadvantages of the prior art.

The above object of the invention is attained by providing a plurality of water films formed by a spraying device, each of which are formed vertically and spaced apart from each other in a treatment chamber in a manner that waste gas streams are sucked through the plurality of water films by a blower, and the impurities contained therein are mixed with water to form a mixture while simultaneously the waste gas streams are humidified. The mixture flows downward and is removed and the humidified waste gas stream is sucked out from the treatment chamber.

Most impurities, such as fluorinated and chlorinated compounds, contained in the waste gas streams are almost dissolved in water. The mixture is flowed into and stored in the tank so as to be further treated, and the amount of the mixture is detected by a set of sensors disposed in the

tank. Therefore, water consumed in the semiconductor etch and deposition process can be supplied in time.

According to an aspect of the invention, each water film is formed by a spraying device disposed in the treatment chamber, which includes a pipe having a nozzle from which the water is sprayed out and a plate disposed on the opposite side of the nozzle. The sprayed-out water impinges on the plate to form the water film.

According to another aspect of the invention, the apparatus for removing impurities from waste gas stream also includes a dehumidifying device. The dehumidifying device includes a chamber having a plurality of perforated buffer plates disposed along the longitudinal axis thereof and a plurality of filtering plates disposed along the longitudinal axis thereof. The perforated buffer plates stabilize the humidified waste gas streams that pass through the plates. The filtering plates remove the solid impurities in the humidified waste gas streams and condense the humidified waste gas streams so as to dehumidify them.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be more understood by reference to the preferred embodiment and the accompanying drawings in which:

Fig. 1A is a front view of an apparatus for removing impurities from effluent waste streams of an embodiment of the invention;

Fig. 1B is a side view of the apparatus of Fig. 1A;

Fig. 1C is the top view of the apparatus of Fig. 1A; and

Fig. 2 is a partial exploded view showing the arrangement of the treatment chamber, the spraying device

and the dehumidifying device of the apparatus for removing impurities of Fig. 1A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Fig. 1A, the apparatus of the preferred embodiment of the invention includes a treatment chamber 20, a liquid spraying device 21, a dehumidifying device 22, a suction blower 23 and a control device 24. The treatment chamber 20, the liquid spraying device 21, the dehumidifying device 22, the suction blower 23 and the control device 24 are arranged together and supported by a supporting frame 25.

Referring to Fig. 2, the treatment chamber 20 is a cylindrical chamber and includes an inlet conduit 20-1 through which the waste gas streams G containing chlorinated compounds and fluorinated compounds (hereinafter referred to as impurities) are introduced, an outlet conduit 20-2 connected to the dehumidifying device 22 and a tank 201. The tank 201 is disposed under the treatment chamber 20 and has a cone-shaped configuration. The tank 201 is communicated with the treatment chamber 20 by a conduit 203. The tank 201 is also fitted with a set of sensors 202 (sensors $202S_1$, $202S_2$ and $202S_3$) disposed on the inner wall thereof so that the level of the liquid in the tank 201 can be sensed and fed back to the control device 25 so as to control the level of the liquid in the tank 201. An exhaust conduit 204 is provided at the bottom of the tank 201.

Referring again to Fig. 2, the spraying device 21 is disposed in the treatment chamber 20. The spraying device 21 includes two pipes 215, 216. The two pipes 215, 216, respectively have nozzles 211N and 212N from which water delivered from the pipe 215 is sprayed out from the nozzle 211N in a downward direction and water delivered form the

pipe 216 is sprayed out from the nozzle 212N in an upward direction. Two plates 213, 214 are disposed on the opposite sides of the nozzle 211N and the nozzle 212N, respectively. The two plates 213, 214 are mounted on the two ends of a T-shaped frame 217 which is mounted on the inner wall of the treatment chamber 20. When water is sprayed out from the nozzles 211N and 212N, it impinges on the plates 213, 214 respectively and forms a first water film W_1 and a second water film W_2, and thus the treatment chamber 20 is divided into three spaces I, II and III.

Referring now to Fig. 1B and Fig. 1C, the dehumidifying device 22 is connected to the suction blower 23 by a connecting pipe 26. When the suction blower 23 is activated, the waste gas streams introduced from the inlet conduit 20-1 are sucked upward through the water films W_1 and W_2 and subsequently the dehumidifying device 22. When the waste gas streams pass through the water films W_1 and w_2, the impurities are mixed with water to form a mixture and simultaneously the waste gas streams are humidified. The mixtures are collected in the tank 200 and exhausted from the exhaust conduit 204 or recycled

Referring now to Fig. 2, the dehumidifying device 22 has the function of stabilizing and dehumidifying the humidified waste gas streams G'. The dehumidifying device 22 has a housing 220 in which one perforated plate 222 and two filtering plates 223, 223 are disposed along its longitudinal axis. The two filtering plates 223, 223 are disposed downstream of the perforated plate 222 and are spaced apart each other. The holes 232p of the perforated plate 232 can stabilize the flow of the waste gas streams. The filtering plates 223 are formed by metal nets and can remove the solid impurities in the humidified waste gas

streams and condense the humidified waste gas streams so as to dehumidify them. The filtering plates 223 can also eliminate the holdup of the humidified waste gas streams when they pass through the perforated plate 232 and the filtering plates 223, 223.

Referring to Fig. 1A, the control device 24 is used to control the flow rate of the waste gas streams passing through the treatment chamber 20 and the dehumidifying device 21, the flow rate of the liquid coming out from the nozzles 211N and 212N and also the level of the liquid mixture in the tank 201 by using the sensors $202S_1$, $202S_2$ and $202S_3$. The structure of the control device 20 is easily understood by those in the field, and thus the detailed description is omitted.

In the structures as described above, the fluorinated and chlorinated compounds contained in waste gas streams from semiconductor etch and deposition processes are absorbed by the water films and removed. The total flow rate of the waste gas streams in the apparatus as described above can reach 6000 liters/m^3. No bubbles are formed in the treatment chamber 20 because no packing is used therein. The humidified waste gas streams exiting the treatment chamber 20, from which the impurities have been removed, are dehumidified by the dehumidifying device 220.